

## CLAIMS

1. A voltage conversion device having a reactor for temporarily storing energy based on a current from a power source, for converting a voltage of the power source, which is input while utilizing the reactor, into a desired voltage through switching of a switching element to output, comprising:

a condition detection circuit for detecting a condition of the power source; and

a control circuit for setting a current range of the power source based on output characteristic of the power source corresponding to the detected condition of the power source and for applying switching control to the switch element such that the current of the power source remains within the current range set by a current range setting circuit.

2. The voltage conversion device according to claim 1, wherein the condition detection circuit detects, as the condition of the power source, an electromotive voltage and inner resistance of the power source.

3. The voltage conversion device according to claim 1, wherein the current range is a range an upper limit of which is a current corresponding to a maximum output in the output characteristics of the power source.

4. The voltage conversion device according to claim 1, wherein the output characteristic of the power source is a characteristic expressed in the form of a secondary function including a variable which is a current of the power source.

5. A voltage conversion device having a structure in which an upper switching element and a lower switching element are serially connected and a reactor for temporarily storing energy based on

a current from a power source is connected to a connection point of the both switching elements, for converting a voltage of the power source, which is input while utilizing the reactor, into a desired voltage through switching of the switching elements,  
5 the voltage conversion device, comprising:

a condition detection circuit for detecting a condition of the power source; and

a control circuit for setting a ratio range based on output characteristics of the power source corresponding to the detected  
10 condition of the power source, the ratio range being a range of ratios each between a period with the upper switching element remaining in an ON state and a period with the lower switching element remaining in an ON state, and for controlling the ratio between the periods with the respective switching elements  
15 remaining in an ON state so as to remain within the set ratio range.

6. The voltage conversion device according to claim 5, wherein the condition detection circuit detects, as the condition of the power source, an electromotive voltage of the power source and  
20 a voltage on an output side of the voltage conversion device.

7. The voltage conversion device according to claim 5, wherein the ratio range is a range a lower limit of which is a ratio corresponding to a maximum output in the output characteristic  
25 of the power source.

8. The voltage conversion device according to claim 5, wherein the output characteristics of the power source is a characteristic expressed in the form of a secondary function including a variable  
30 which is a ratio between the periods with the respective switching elements remaining in an ON state.

9. A voltage conversion device having a reactor for temporarily storing energy based on a current from a power source, for converting

a voltage of the power source, which is input while utilizing the reactor, into a desired voltage through switching of a switching element to output, comprising:

5 a voltage detection circuit for detecting a voltage of the power source; and

a control circuit for applying switching control to the switching element such that the detected voltage remains within a predetermined range.

10 10. The voltage conversion device according to claim 9, wherein the predetermined range is a range determined based on an electromotive voltage of the power source.

11. The voltage conversion device according to claim 10, wherein  
15 the predetermined range is a range a lower limit of which is a half of the electromotive voltage of the power source.

12. A voltage conversion device for converting a voltage of a power source into a desired output voltage, comprising:

20 a reactor having one end connected to one end of the power source;

a switching circuit having a first switching element positioned between other end of the reactor and an output terminal and a second switching element positioned between the other end  
25 of the reactor and other end of the power source; and

a control circuit for controlling switching of the first and second switching elements of the switching circuit,

wherein

30 the control circuit limits a ratio between periods with the first and second switching elements remaining in an ON state such that the ratio remains in a predetermined range, based on permissible current capacities of the first and second switching elements.

13. The voltage conversion device according to claim 12, wherein the control circuit controls such that a proportion of a period with either one of the first and second switching elements remaining in an ON state, relative to combined periods with the first and second switching elements relatively remaining in an ON state remains equal to or smaller than  $(V_{bo} - R_b \times I_{bmax}) / V_c$ ,  $V_{bo}$  representing an output voltage of the power source,  $R_b$  representing inner resistance of the power source,  $I_{bmax}$  representing a permissible current capacity of the switching element, and  $V_c$  representing the output voltage.

14. A voltage conversion device for converting a voltage of a power source into a desired output voltage, comprising:  
a reactor having one end connected to one end of the power source;  
a switching circuit having a first switching element positioned between other end of the reactor and an output terminal and a second switching element positioned between the other end of the reactor and other end of the power source;  
a control circuit for controlling switching of the first and second switching elements of the switching circuit; and  
a current detector for detecting a current flowing through the first or second switching element,  
wherein  
the control circuit limits a ratio between periods with the first and second switching elements remaining in an ON state based on the detected current value such that the ratio remains in a predetermined range.

15. The voltage conversion device according to claim 14, wherein the control circuit controls such that a proportion of a period with either one of the first and second switching elements remaining in an ON state, relative to combined periods with the first and second switching elements relatively remaining in an ON state

remains equal to or smaller than  $(V_{bo}-R_b I_{bmax})/V_c$ ,  $V_{bo}$  representing an output voltage of the power source,  $R_b$  representing inner resistance of the power source,  $I_{bmax}$  representing a maximum value of a current of the power source, and  $V_c$  representing the  
5 output voltage.

16. A driving system for driving a load using a power output from a voltage conversion device for converting a voltage of a power source into a desired output voltage,  
10 wherein  
the voltage conversion device according to any one of claims 1 through 11 is used as the voltage conversion device, and  
the driving system comprises a load driving control circuit for controlling an output of the load while receiving a voltage  
15 output from the voltage conversion device.

17. The driving system according to claim 16, further comprising:  
a storage circuit positioned between the voltage conversion device and the load, for temporarily storing an output from the  
20 voltage conversion device,  
wherein  
the load driving control circuit has a circuit for limiting an output of the load according to a stored voltage of the storage circuit.

25 18. The driving system according to claim 17, wherein the load driving control circuit terminates driving of the load when a deviation between the stored voltage and a target voltage of the storage circuit is equal to or exceeds a predetermined value despite  
30 control by the load driving control circuit.

19. The driving system according to claim 16, wherein the load has a motor for rotation driving while receiving a power and a power adjustment circuit for adjusting the power output from the

voltage conversion device into a power suitable for driving of the motor and supplying to the motor.

20. A vehicle carrying the driving system according to claim  
5 19, wherein the motor is a motor for a vehicle.

21. A voltage conversion method for converting a voltage of a power source, which is input while utilizing a reactor for temporarily storing energy based on a current from the power source,  
10 into a desired voltage through switching of a switching element to output, comprising:

detection of a condition of the power source;

setting a current range of the power source based on output characteristic of the power source corresponding to the detected  
15 condition of the power source; and

applying switching control to the switch element such that the current of the power source remains within the set current range.

20 22. A method for converting a voltage of a power source utilizing a voltage conversion device having a structure in which an upper switching element and a lower switching element are serially connected and a reactor for temporarily storing energy based on a current from a power source is connected to a connection point  
25 of the both switching elements, into a desired voltage through switching of the switching elements, the voltage of the power source being input while utilizing the reactor, the method, comprising:

detecting a condition of the power source;

30 setting a ratio range based on output characteristics of the power source corresponding to the detected condition of the power source, the ratio range being a range of ratios each between a period with the upper switching element remaining in an ON state and a period with the lower switching element remaining in an ON state; and

controlling the ratio between the periods with the respective switching elements remaining in an ON state so as to remain within the set ratio range.

5 23. A voltage conversion method for converting a voltage of a power source, which is input while utilizing a reactor for temporarily storing energy based on a current from the power source, into a desired voltage through switching of a switching element to output, comprising:

10 detecting a voltage of the power source; and  
applying switching control to the switching element such that the detected voltage remains within a predetermined range.

24. A voltage conversion method for converting a voltage of a power source into a desired output voltage, comprising a reactor having one end connected to one end of the power source and a switching circuit having a first switching element positioned between other end of the reactor and an output terminal and a second switching element positioned between the other end of the reactor and other end of the power source,

20 wherein  
a ratio between periods with the first and second switching elements remaining in an ON state is limited so as to remain in a predetermined range, based on permissible current capacities  
25 of the first and second switching elements.

25. The voltage conversion method according to claim 24, comprising:

controlling such that a proportion of a period with either  
30 one of the first and second switching elements remaining in an ON state, relative to combined periods with the first and second switching elements relatively remaining in an ON state remains equal to or smaller than  $(V_{bo} - R_b \times I_{bmax}) / V_c$ ,  $V_{bo}$  representing an output voltage of the power source,  $R_b$  representing inner

resistance of the power source,  $I_{bmax}$  representing a permissible current capacity of the switching element, and  $V_c$  representing the output voltage.

5 26. A voltage conversion method for converting a voltage of a power source into a desired output voltage, comprising a reactor having one end connected to one end of the power source and a switching circuit having a first switching element positioned between other end of the reactor and an output terminal and a second  
10 switching element positioned between the other end of the reactor and other end of the power source,

wherein .

a ratio between periods with the first and second switching elements remaining in an ON state is limited so as to remain in  
15 a predetermined range, based on a magnitude of a current flowing through the first or second switching element.

27. The voltage conversion method according to claim 26, comprising:

20 controlling such that a proportion of a period with either one of the first and second switching element remaining in an ON state, relative to combined periods with the first and second switching element relatively remaining in an ON state remains equal to or smaller than  $(V_{bo} - R_b I_{bmax}) / V_c$ ,  $V_{bo}$  representing an output  
25 voltage of the power source,  $R_b$  representing inner resistance of the power source,  $I_{bmax}$  representing a maximum value of a current of the power source, and  $V_c$  representing the output voltage.

28. A computer readable recording medium storing a control  
30 program for controlling a voltage conversion device having a reactor for temporarily storing energy based on a current from a power source, for converting a voltage of the power source, which is input while utilizing the reactor, into a desired voltage through switching of a switching element to output, the program having



a computer to execute:

setting of a current range of the power source based on output characteristics of the power source corresponding to a condition of the power source; and

5        switching control of the switching element such that the current of the power source remains within a current range set by a current range setting circuit.

29.    A computer readable recording medium storing a control  
10    program for controlling a voltage conversion device having a structure in which an upper switching element and a lower switching element are serially connected and a reactor for storing, as energy, a current from a power source is connected to a connection point of both the switching elements, for converting a voltage of the  
15    power source, which is input while utilizing the reactor, into a desired voltage through switching of a switching element to output, the program having a computer to execute:

setting of a ratio range based on output characteristics of the power source corresponding to a condition of the power source,  
20    the ratio range being a range of ratios each between a period with the upper switching element remaining in an ON state and a period with the lower switching element remaining in an ON state, and

control of the ratio between the periods with the respective switching elements remaining in an ON state so as to remain within  
25    the ratio range set by a ratio range setting circuit.

30.    A computer readable recording medium storing a control  
program for controlling a voltage conversion device having a reactor for temporarily storing energy based on a current from  
30    a power source, for converting a voltage of the power source, which is input while utilizing the reactor, into a desired voltage through switching of a switching element to output, the program having a computer to execute switching control of the switching element such that the voltage of the power source remains within a

predetermined range.

31. Acontrolprogramforcontrollingavoltageconversiondevice comprising a reactor having one end connected to one end of a power  
5 source and a switching circuit having a first switching element positioned between other end of the reactor and an output terminal and a second switching element positioned between the other end of the reactor and other end of the power source, for converting a voltage of the power source into a desired output voltage, the  
10 program having a computer to execute:

limitation of a ratio between periods with the first and second switching elements remaining in an ON state so as to remain in a predetermined range, based on permissible current capacities of the first and second switching elements.

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32. Acontrolprogramforcontrollingavoltageconversiondevice comprising a reactor having one end connected to one end of a power source and a switching circuit having a first switching element positioned between other end of the reactor and an output terminal  
20 and a second switching element positioned between the other end of the reactor and other end of the power source, for converting a voltage of the power source into a desired output voltage, the program having a computer to execute:

limitation of a ratio between periods with the first and  
25 second switching elements remaining in an ON state so as to remain in a predetermined range, based on a magnitude of a current flowing through the first or second switching element.

33. Acontrolprogramforcontrollingavoltageconversiondevice  
30 having a reactor for temporarily storing energy based on a current from a power source, for converting a voltage of the power source, which is input while utilizing the reactor, into a desired voltage through switching of a switching element to output, the program having a computer to execute:

setting of a current range of the power source based on output characteristic of the power source corresponding to a condition of the power source, and

switching control of the switch element such that the current  
5 of the power source remains within the current range set by a current range setting circuit.

34. A control program for controlling a voltage conversion device having a structure in which an upper switching element and a lower  
10 switching element are serially connected and a reactor for storing energy based on a current from a power source is connected to a connection point of both the switching elements, for converting a voltage of the power source, which is input while utilizing the reactor, into a desired voltage through switching of a switching  
15 element to output, the control program having a computer to execute:

setting of a ratio range based on output characteristics of the power source corresponding to a condition of the power source, the ratio range being a range of ratios each between a period with the upper switching element remaining in an ON state and a period  
20 with the lower switching element remaining in an ON state, and

control of the ratio between the periods with the respective switching elements remaining in an ON state so as to remain within the ratio range set by a ratio range setting circuit.

25 35. A control program for controlling a voltage conversion device having a reactor for temporarily storing energy based on a current from a power source, for converting a voltage of the power source, which is input while utilizing the reactor, into a desired voltage through switching of a switching element to output, the program  
30 having a computer to execute:

switching control of the switch element such that the voltage of the power source remains within a predetermined range.

36. A control program for controlling a voltage conversion device

comprising a reactor having one end connected to one end of a power source and a switching circuit having a first switching element positioned between other end of the reactor and an output terminal and a second switching element positioned between the other end of the reactor and other end of the power source, for converting a voltage of the power source into a desired output voltage, the program having a computer to execute:

limitation of a ratio between periods with the first and second switching elements remaining in an ON state so as to remain in a predetermined range, based on permissible current capacities of the first and second switching elements.

37. A control program for controlling a voltage conversion device comprising a reactor having one end connected to one end of a power source and a switching circuit having a first switching element positioned between other end of the reactor and an output terminal and a second switching element positioned between the other end of the reactor and other end of the power source, for converting a voltage of the power source into a desired output voltage, the program having a computer to execute:

limitation of a ratio between periods with the first and second switching elements remaining in an ON state so as to remain in a predetermined range, based on a magnitude of a current flowing through the first or second switching element.